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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/589,852

11/27/2006

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PHKF-05004US

3677

21254 7590 05/27/2009
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EXAMINER

WHALEN, DANIEL B

ART UNIT

PAPER NUMBER

2829

MAIL DATE

DELIVERY MODE

05/27/2009

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/589,852	Applicant(s) ICHINOSE ET AL.	
	Examiner DANIEL WHALEN	Art Unit 2829	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 14 April 2009.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,4,5,8 and 14-25 is/are pending in the application.
- 4a) Of the above claim(s) 14,15,17,20,22-24 and 27 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,4,5,8,16,18,19,21,25 and 26 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 08/17/2006 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

This office action is in response to an amendment after final rejection filed on 02/10/2009. Claims 2, 3, 6, 7, and 9-13 are cancelled and claims 14, 15, and 17 are withdrawn.

Election/Restrictions

1. Newly amended/submitted **claims 20, 22-24, and 27** directed to an invention that is independent or distinct from the invention originally claimed for the following reasons:
2. Restriction to one of the following inventions is required under 35 U.S.C. 121:
 - I. Claims 1, 4, 5, 8, 16, 18, 19, 21, 25, and 26, drawn to method, classified in class 438, subclass 510.
 - II. Claims 20, 22-24, and 27, drawn to a device, classified in class 257, subclass 102.

The inventions are distinct, each from the other because of the following reasons:

Inventions group I and group II are related as process of making and product made. The inventions are distinct if either or both of the following can be shown: (1) that the process as claimed can be used to make another and materially different product or (2) that the product as claimed can be made by another and materially different process (MPEP § 806.05(f)). In the instant case, for example, the claimed product can be made by growing the Ga₂O₃ single crystal system with the n-type dopant together instead of adding the n-type dopant to the Ga₂O₃ single crystal system.

Since applicant has received an action on the merits for the originally presented method invention, this invention has been constructively elected by original presentation for prosecution on the merits. Accordingly, claims 20, 22-24, and 27 have been withdrawn from consideration as being directed to a non-elected invention. See 37 CFR 1.142(b) and MPEP § 821.03.

Double Patenting

3. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the “right to exclude” granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

4. **Claims 1, 16, and 19** are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claim 6 or 31 of copending Application No. 12/155,991 in view of Harwig et al. (“Electrical Properties of β -Ga₂O₃ Single Crystals. II,”; hereinafter “Harwig”). Although the conflicting claims are

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not identical, they are not patentably distinct from each other because the subject matter as claimed in the pending application in the instant office action are obvious variants of the noted claims of copending Application No. 12/155,991 in view of Harwig.

5. Re claims 1 and 19, only difference between claims 1 and 19 of the instant application and claim 31 of the copending application is that the copending application does not explicitly disclose the n-type dopant that is doped into the Ga_2O_3 system single crystal is one of Zr, Si, Hf, Ge, Sn, and Ti. Harwig discloses that the n-type dopant is one of Zr, Si, Hf, Ge, Sn, and Ti (Introduction & Experimental, e.g. Zr) so as to increase a conductivity of the Ga_2O_3 system single crystal. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to combine the teaching of copending application in view of Harwig so as to increase the conductivity of the Ga_2O_3 system single crystal. It is noted that resistivity is simply the reciprocal of its conductivity. Therefore, once the conductivity is obtained, then the resistivity is also obtained.

6. Re Claim 16, only difference between claims 16 of the instant application and claim 6 of the copending application is that the copending application does not explicitly disclose a specific element for the p-type dopant that is doped into the Ga_2O_3 system single crystal. Harwig discloses the p-type dopant such as Mg (Introduction & Experimental) so as to decrease a conductivity of the Ga_2O_3 system single crystal. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to combine the teaching of copending application in view of Harwig so as to decrease the conductivity of the Ga_2O_3 system single crystal. It is noted that resistivity

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is simply the reciprocal of its conductivity. Therefore, once the conductivity is obtained, then the resistivity is also obtained.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

Drawings

7. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, “change a resistivity of said Ga₂O₃ system single crystal *linearly* with an added amount of the n-type dopant” in claim 1 and “changing the resistivity of the Ga₂O₃ system single crystal *linearly* with the added amount of the n-type dopant” in claim 19 **must** be shown or the feature(s) canceled from the claim(s). Also, “contacting a Ga₂O₃ polycrystalline raw material comprising a predetermined dopant to a Ga₂O₃ seed crystal” in claim 16 **must** be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as “amended.” If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for

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consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 112

8. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

9. **Claims 1, 4, 5, 8, 19, 25, and 26** are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The recitation of "linearly" in line 5 of claim 1 and in line 7 of claim 19 is not described in the original specification. Applicant should note that fig. 2 does not show any linear relationship between the resistivity of the Ga_2O_3 system single crystal and the added amount of the n-type dopant. Claims 4, 5, 8, 25, and 26, which depend from either claim 1 or 19, are rejected.

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10. **Claim 21** is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The recitation of "exclusively dependent" is not supported by the original specification.

11. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

12. **Claims 1, 4, 5, 8, 26** are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The recitation, "wherein said n-type dopant...and Ti" in lines 7-8 of claim 1 renders claim indefinite since it is not clear to one of ordinary skill in the art whether the list of elemental choice is for the n-type dopant or for the Ga_2O_3 system single crystal prior adding n-type dopant. Furthermore, the recitation "an n-type dopant" appears to be having antecedent basis issue.

13. **Claim 21** is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The recitation, "exclusively dependent", renders claim indefinite since it is not clear how the conductivity is exclusively dependent on the added amount of the p-type dopant when there are other conductivity controlling features such as temperature/pressure, etc.

Insofar as definite, and as best understood, the claims are rejected as follows.

Claim Rejections - 35 USC § 103

14. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

15. **Claims 1, 4, 5, and 19** are rejected under 35 U.S.C. 103(a) as being unpatentable over Harwig ("Electrical Properties of β -Ga₂O₃ Single Crystals. II,"; hereinafter "Harwig").

16. **Re Claim 1**, Harwig teaches a method of controlling a conductivity of a Ga₂O₃ system single crystal, comprising:

adding (doping) a n-type dopant (Zr) to the Ga₂O₃ system single crystal to change a resistivity of said Ga₂O₃ system single crystal linearly with an added amount of the n-type dopant (page 205, Introduction, lines 1-15 & Experimental line 1-13), wherein said n-type dopant comprises the n-type dopant for controlling said conductivity of the Ga₂O₃ system single crystal comprising one of Zr, Si, Hf, Ge, Sn, and Ti (Zr).

It is noted that the resistivity is simply the reciprocal of its conductivity and thus Harwig teaching the conductivity of Ga₂O₃ system single crystal also teaches the resistivity of the Ga₂O₃ system single crystal. This reasoning is also applied to the subsequent claims.

Furthermore, regarding the recitation of changing the resistivity of the Ga₂O₃ system single crystal linearly with the added amount of dopant, since the structure

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recited in Harwig is substantially identical to that of the claims (Ga₂O₃ system single crystal) with the process (adding n-type dopant comprising one of Zr, Si, Hf, Ge, Sn, and Ti), claimed properties or functions are presumed to be inherent. Or where the claimed and prior art products are identical or substantially identical in structure or composition, or are produced by identical or substantially identical processes, a prima facie case of either anticipation or obviousness has been established. See *In re Best*, 195 USPQ 430, 433 (CCPA 1977) and MPEP 2112.01. This reasoning is also applied to the rejections of subsequent claims.

Re Claims 4 and 5, teaching of Harwig has been discussed above except a numerical values of the resistivity and a carrier concentration. However, it is noted that the Harwig teaches an identical process, such as doping a predetermined dopant to the Ga₂O₃ system single crystal, and an identical material, such as n-type dopant. Therefore, a value of 2.0×10^{-3} to $8.0 \times 10^2 \Omega\text{cm}$ as the desired resistivity by adding the n-type dopant and a carrier concentration within a range of 5.5×10^{15} to $2.0 \times 10^{19} \Omega\text{cm}$ are obtained. MPEP 2112.01. Furthermore, it has held that discovering an optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233.

Re Claim 19, Harwig teaches a method of manufacturing a Ga₂O₃ system single crystal, comprising:

adding an n-type dopant (Zr) to the Ga₂O₃ system single crystal, the n-type dopant comprising one of Zr, Si, Hf, Ge, Sn, and Ti (page 205, Introduction, lines 1-15);
and

manufacturing the Ga_2O_3 system single crystal having a resistivity depending on an added amount of the n-type dopant by changing the resistivity of the Ga_2O_3 system single crystal linearly with the added amount of the n-type dopant (fig. 1). Regarding changing the resistivity of the Ga_2O_3 system single crystal linearly with the added amount of the n-type dopant, see the rejection of claim 1.

17. **Claim 8** is rejected under 35 U.S.C. 103(a) as being unpatentable over Harwig in view of Ichinose et al. (US 2004/0007708 A1; hereinafter "Ichinose").

Re Claim 8, teaching of Harwig has been discussed above. However, Harwig does not explicitly disclose that the Ga_2O_3 single crystal is prepared with a Ga_2O_3 polycrystalline raw material and wherein the Ga_2O_3 polycrystalline raw material has a purity of 6N. Ichinose disclose that the Ga_2O_3 single crystal is prepared with a Ga_2O_3 polycrystalline raw material so as to apply to as a substrate to various semiconductor devices since the Ga_2O_3 single crystal would be produced in good reproducibility (fig. 3 and paragraph 55-67). Regarding the purity of 6N, though combined teaching of Harwig and Ichinose does not explicitly disclose that the purity of Ga_2O_3 system single crystal is 6N, one of ordinary skill in the art would recognize that 6N of Ga_2O_3 is more pure compared to the typical purity of 4N of Ga_2O_3 by optimizing the gas flow and therefore 6N has an improved electrical property by having less impurity in the system compared to 4N of Ga_2O_3 . Therefore, it would have been obvious to one of ordinary skill in the art to combine the teaching of Harwig with that of Ichinose so as to apply to as a substrate to various semiconductor devices and also, regarding purity, to optimize the Ga_2O_3

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system to have the purity of 6N over typical 4N for improved electrical property with less impurity in the system.

18. **Claims 25 and 26** are rejected under 35 U.S.C. 103(a) as being unpatentable over Harwig in view of Ueda et al. ("Synthesis and control of conductivity of ultraviolet transmitting β -Ga₂O₃ Single Crystal"; hereinafter "Ueda").

Re Claims 25 and 26, teaching of Harwig has been discussed above. However, Harwig does not explicitly disclose that the n-type dopant comprises one of Si, Hf, and Sn. Ueda discloses adding the dopants such as Sn to the Ga₂O₃ single crystal to control the conductivity (page 1361). Therefore, it would have been obvious to one of the ordinary skill in the art at the time of the invention to combine the teaching of Harwig with that of Ueda as Sn as readily available n-type dopant to the Ga₂O₃ single crystal to obtain n-doped Ga₂O₃ single crystal.

19. **Claims 16, 18, and 21** are rejected under 35 U.S.C. 103(a) as being unpatentable over Harwig in view of Ichinose.

20. **Re Claim 16**, Harwig teaches a method of controlling a conductivity of a Ga₂O₃ system single crystal, comprising:

growing the Ga₂O₃ system single crystal such that said predetermined dopant is substituted for Ga in the Ga₂O₃ system single crystal to obtain a desired resistivity in the Ga₂O₃ system single crystal of $1 \times 10^3 \Omega\text{cm}$ or greater (fig. 1; page 205, introduction line 1-15, experimental line 1-13), wherein said predetermined dopant comprises a p-

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type dopant (Mg) for controlling a conductivity of the Ga_2O_3 system single crystal, said p-type dopant comprising one of H, Li, Na, K, Rb, Cs, Fr, Be, Mg, Ca, Sr, Ba, Ra, Mn, Fe, Co, Ni, Pd, Cu, Ag, Au, Zn, Cd, Hg, Tl, and Pb (fig. 1; page 205, introduction line 1-15, experimental line 1-13).

It is noted that the resistivity is simply the reciprocal of its conductivity and thus Harwig teaching the conductivity of Ga_2O_3 system single crystal also teaches the resistivity of the Ga_2O_3 system single crystal. This reasoning is also applied to the rejection of subsequent claims.

However, Harwig does not disclose contacting a Ga_2O_3 polycrystalline raw material comprising a predetermined dopant to a Ga_2O_3 seed crystal; and growing the Ga_2O_3 system single crystal on the Ga_2O_3 seed crystal. Ichinose discloses contacting a Ga_2O_3 polycrystalline raw material comprising a predetermined dopant to a Ga_2O_3 seed crystal and growing the Ga_2O_3 system single crystal on the Ga_2O_3 seed crystal since the Ga_2O_3 single crystal would be produced in good reproducibility (fig. 3 and paragraph 55-67). Therefore, it would have been obvious to one of ordinary skill in the art to combine the teaching of Harwig with that of Ichinose so as to apply to as a substrate to various semiconductor devices.

It is noted that the combined teaching of Harwig and Ichinose teaches an identical process, such as doping the predetermined dopant to the Ga_2O_3 system single crystal, and an identical material, such as the p-type dopant. Therefore, a value of $1 \times 10^3 \Omega\text{cm}$ or greater as the desired resistivity by adding the p-type dopant are obtained. MPEP 2112.01. Furthermore, applicant should note that it has held that discovering an

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optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980). It is also noted that one of the ordinary skill in the art would recognize that when the predetermined dopant such as p-type dopant (Mg) is doped to the Ga_2O_3 system single crystal, the dopant is substituted for Ga in the Ga_2O_3 system single crystal.

Re Claim 18, the combined teaching of Harwig and Ichinose has been discussed above except the purity. Nevertheless, one of ordinary skill in the art would recognize that 6N of Ga_2O_3 is more pure compared to the typical purity of 4N of Ga_2O_3 by optimizing the gas flow and therefore 6N has an improved electrical property by having less impurity in the system compared to 4N of Ga_2O_3 . Therefore, it would have been obvious to one of ordinary skill in the art to optimize the Ga_2O_3 system to have the purity of 6N over typical 4N for improved electrical property with less impurity in the system.

Re Claim 21, Harwig discloses that the conductivity of the Ga_2O_3 system is dependent on an added amount of said p-type dopant (see fig. 1).

Response to Arguments

21. Applicant's arguments with respect to amended claims have been considered but are moot in view of the new ground(s) of rejection as set forth above in the Office Action.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to DANIEL WHALEN whose telephone number is (571)270-3418. The examiner can normally be reached on Monday-Friday, 7:30am to 5:00pm, EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ha Nguyen can be reached on (571) 272-1678. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for

published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/D. W./
Examiner, Art Unit 2829
05/22/2009

Daniel Whalen
/Michael S. Lebentritt/

Primary Examiner, Art Unit 2829